matter, even asserted any search area required for any of the identified inventions where no relevant prior art would be expected for another, much less, and search are required for non-elected claims 11 and/or 12 which would not be required for elected claims 1 - 10. On the contrary, it is respectfully submitted that the mark of claim 11 would clearly be comprehended by a search for the subject matter of elected claims 1 - 10 directed to a metrology method using such a mark and the combination of elements recited in claim 12 are also comprehended by the subject matter of the elected claims since a spectroscopic scatterometer is recited in claim 3, comparison is recited in claim 9 and storage of spectral curves is certainly within the scope of claim 1 since at least claims 2, 9 and 10 are directed to obtaining spectral curves through simulation.

Therefore, contrary to the Examiner's comments, it does not, in fact, appear that any serious burden of examination would be presented in the absence of the requirement for restriction and, as the Examiner is aware, *both* distinctness of the identified inventions *and* a serious burden are required to support a proper requirement for restriction. Therefore, it is respectfully requested that the requirement for restriction be reconsidered and withdrawn and non-elected claims 11 and 12 considered on their merits.

Claims 1 - 10 have been rejected under 35 U.S.C. §103 as being unpatentable over "Kawakubo et al. in combination with one of ordinary skill in the requisite art's ability" and claim 1 has been additionally rejected under 35 U.S.C. §102 as being anticipated by Kawakubo et al. These grounds of rejection are respectfully traversed.

Initially, it is noted that the Examiner asserts that "one of ordinary skill in the art in possession of the Kawakubo et al. teachings would have found use of

all well known interference pattern generating devices and their associated property characteristics in the method of Kawakubo et al. absent objective evidence of high probative value to the contrary" because "Kawakubo et al. states that numerous different image processing type position detecting methods can be utilized to include the two beam interference type detection method and alludes to the fact that any well known type apparatus could be utilized in this manner." While these assertions by the Examiner are ambiguous as to intended meaning, they are also respectfully submitted to be clearly incorrect under any interpretation. If, for example, the Examiner is intending to assert that the teachings and suggestions of Kawakubo et al. and the level of ordinary skill in the art are so complete that no invention utilizing an interference pattern for position detection could ever be unobvious thereover, the assertion is manifestly incorrect and improper since it is the nature of invention to provide an unexpected result by a novel process or combination of elements. If the Examiner it asserting that it would be obvious to use what is "well known", the assertion appears to be substantially trivial and is also incorrect and improper since the Examiner has provided no indication, much less evidence, of what is considered to be well-known beyond the direct and literal teachings of Kawakubo et al. and, as will be discussed below, has not shown that (or how) Kawakubo et al. even approaches answering the recitations of the claims and, moreover, it is respectfully submitted that any modification of Kawakubo et al. in order to do so would be improper and without motivation even if the Examiner had provided an evidentiary basis for showing that such a modification was within the level of ordinary skill in the art for the simple reason that any such modification would preclude the arrangement of Kawakubo et al. from operating in the manner intended.

Therefore, it is respectfully submitted that the grounds of rejection asserted by the Examiner are clearly in error and without evidentiary basis and no *prima facie* demonstration of anticipation or obviousness has been made or can be made based on Kawakubo et al. alone or in combination with the level of ordinary skill in the art at the time the invention was made. Further, the Examiner's failure to even colorably make a *prima facie* demonstration of the propriety of either asserted ground of rejection clearly underscores the impropriety of, in essence, requiring "evidence of high probative value". Simply put, if no *prima facie* demonstration of the propriety of a rejection is made, there is no basis for requiring evidence to the contrary or, for that matter, any response at all, since the Examiner has not shown any reason that the Applicant is not entitled to allowance as a matter of right under 35 U.S.C. §101.

Substantively, Kawakubo et al. does not teach or suggest the claimed subject matter since, while Kawakubo et al. teaches a diffraction grating as a positioning mark for overlay alignment, that diffraction grating is not formed by two different lithographic exposures which are subject to misalignment which causes changes in spacing of the lines of the grating to which diffraction and resultant interference pattern is highly sensitive, as exploited by the invention. The formation of the pattern in two separate steps is required in all of the independent claims of the present application; in claim 1 by not only the recitation of formation of first and second separated features in respective separate steps but also the recitation that the second separated features are "interleaved between said first separated features" thus requiring that the first separated features exist at the time the second separated features are formed between them.

In contrast, the diffraction grating marks of Kawakubo et al. are placed on a surface and alignment is achieved by illuminating the diffraction grating with a slit-shaped pattern such that "diffracted light is *emitted in a predetermined direction* as the wafer mark MX coincides with the slit-shaped light spot 13A" (column 20, lines 31 - 35, emphasis added - see also column 21, lines 20 - 32 and 62 - 67 and column 22, lines 1 - 4, including passages relied on by the Examiner). It follows from the basic physics of diffraction gratings that the spacing of lines therein not be subject to variation (which variation it is the purpose of the present invention to quantify without imaging through comparison/matching with simulated or empirical data) since variation of spacing would change the angle at which light is "emitted" by the diffraction grating, when illuminated by a slit-shaped pattern. Therefore, as alluded to above, Kawakubo et al. does not answer the recitations of any claim in the application and cannot properly be modified to do so *regardless of the level or content of ordinary skill in the art* since operation of Kawakubo et al. in the intended manner would be precluded by such a modification. See In re Gordon, 221 USPQ 1125 (Fed. Circ., 1984) That is, variation in spacing of the lines of the diffraction grating as an incident of being formed in separate operations that are subject to misalignment for that reason; which misalignment is measured without imaging by the invention, as claimed, would alter the angle(s) of light emission when illuminated and thus prevent reliable detection of alignment, much less its quantitative measurement, as provided by the invention.

The invention, as claimed, and Kawakubo et al. are thus mutually exclusive of each other for that reason and Kawakubo et al. clearly does not and cannot anticipate any claim in the application or provide

teachings, suggestions and/or evidence of the level of ordinary skill in the art which could support the conclusion of obviousness which the Examiner has asserted. By the same token, it is respectfully submitted that Kawakubo et al. teaches directly away from the present invention, as claimed. Therefore, both the nature of and motivation for any modification thereof to answer the claim recitations is only to be found, if at all, through hindsight in light of the present disclosure, particularly since the Examiner has not identified any particular subject matter other than that directly disclosed by Kawakubo et al. which is considered to be "well known". Moreover, it does not appear from the statement of the rejection that the Examiner has addressed any particular recitation of any step of the claimed method beyond an overly broad assertion (if correctly understood) to the effect that any known detector could be used in Kawakubo et al., while failing to relate any particular teaching of Kawakubo et al. to any step of any claim; the Examiner merely asserting that it discloses "measuring overlay alignment" (which it does not, but only *provides for* alignment) "utilizing an interference pattern" while failing to address the recitations of formation of the first and second separated features where the second separated features are "interleaved between the first separated features" and both sets of features are illuminated to develop an interference pattern as recited in claim 1, much less addressing the recitations of the dependent claims such as simulation, use of broadband light, sensing particular parameters of the diffracted light, optimization of matching of data, etc.

Therefore, it is respectfully submitted that the stated grounds of rejection are clearly in error, improper and without evidentiary basis. The stated grounds of rejection effectively ignore explicit

recitations of the claims and are based on an overly broad assessment of the scope and content of the prior art, ambiguously stated. Accordingly, it is respectfully requested that the rejections be reconsidered and withdrawn.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041.

Respectfully submitted,

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APPENDIX

Page 9, line 3+:

Referring now to the drawings, and more particularly to Figures 1A, 1B and 1C, there is shown a typical box-in-box metrology feature exemplary of features for such purposes known and used in the art. The box-in-box feature 16 shown in Figure 1C is a composite feature formed by two overlaid lithographic exposures corresponding respectively to features 12 and [24] 14 of Figures 1A and 1B, respectively, which are generally sequentially performed and each preceded by deposition of a layer of resist and followed by development of resist layer and possibly including etching or material deposition processes between the lithographic exposures. One feature will be larger than the other and the smaller feature should be of dimensions which, ideally, closely approach the minimum feature size of interest.

Page 9, line 20+:

At the present state of the art, however, the smaller feature is generally produced with a transverse dimension of about ten microns and the larger feature is generally produced with a transverse dimension of about twenty microns. Such dimensions are about an order of magnitude or more larger than minimum feature size of the current generation of commercially available integrated circuits. Such a difference in minimum feature size puts stringent [demand] demands on processing of measurement data to hold the overlay accuracy budget within a small fraction of the minimum feature size and may provide profile shapes which are not representative of the profiles of much smaller features. The relative positions of these features and their material profiles must then be observed by optical microscopy, SEM or AFM in separate processes

and the resulting data processed. All of these processes are imaging techniques and all have serious limitations. The optical microscopy method is limited in image resolution. The AFM method is a quasi-contact technique and is very slow. The SEM method requires that observation be performed in a high vacuum and transfer of the wafer and pumping an expensive vacuum chamber down to an appropriate pressure greatly extends the amount of time required for measurement to be made; which is, itself, of significant duration of about ten seconds or more per measurement. It may be required for the wafer to be sectioned and illuminated at different angles requiring different set-up for different measurements. In any case, measurement is destructive, indirect and of necessarily low throughput while requiring apparatus and process methodology of high (and increasing) complexity and cost as well as substantial processing of the raw measurement data.

Page 15, line 1+:

Figure 3 shows a plurality of peaks of light amplitude at different frequencies or wavelengths (calibrated as a function of 1/pixel which is basically equivalent to inverse wavelength but specifically related by the calibration to multiples of lithographic tool resolution or minimum feature size). Sharp peaks 32 and broad peaks 34 are evident and are dependent on incident geometry, reflectivity and profile of individual lines. In Figure 3, both the sharp peaks and the broad peaks are substantially symmetrical while in Figure 4, substantial asymmetry is evident, particularly in the broad peaks 42 and the sharp peaks 44 of longer wavelength. This asymmetry of peaks in Figure 4 is due to the different spacings caused by misalignment in the composite pattern of Figure 2B but is substantially absent from Figure 3 since the pitch of the marks is substantially constant. Thus, it is

seen that the shape of the spectral curve is extremely sensitive to the existence of slight variation in spacing of a periodic structure (which would include features at a [pluraity] plurality of pitches or periodic spacings due to any misalignment) and even small degrees of misalignment can be discriminated by inspection and quantified by comparison with [empiriocal] empirical or simulated data.

Page 16, line 28+:

Therefore, for a given feature size regime and with at least some similarity in feature geometry (e.g. pitch, width and profile) a calibration or verification of the process in accordance with the invention may be achieved by exposing overlaid patterns as described above in connection with Figures 2, 2A and 2B with differing misalignments and making spectroscopic observations such as [figures] Figures 3 and 4, followed by processing of the spectral curves and comparison to stored curves obtained from prior simulations to determine the misalignment errors. The same patterns can then be observed or measured with SEM or AFM and the results compared to the calculated misalignments. If the results do not agree, then it may be necessary to perform additional simulations to better model the composite overlay target physical properties using SEM cross-sectional data.

Page 17, line 10+:

Referring now to Figure 7, the methodology of the invention will now be summarized. Composite overlay targets 71 are obtained by superimposition of two successive mask level patterns in a reserved area of [of] the wafer 72, referred to as an overlay measurement mark area, The second mask level is defined as a resist structure and the first mask level is defined as an etched structure on the same area of

the wafer substrate.

Claims 8 and 12:

8. (Amended) A [metod] method as recited in claim 1 wherein said detection measures amplitude and phase.

12. (Twice Amended) A non-imaging metrology apparatus comprising

means for storing spectral curves,

a specular spectroscopic scatterometer for measuring reflection from a plurality of marks formed by two levels of lithographic exposures and forming a periodic structure, and

means for comparing processed signals output from said specular spectroscopic scatterometer with said spectral curves to evaluate misalignment of said two levels of lithographic exposures.